ABSTRACT
                The 2-year NSF (National Science Foundation)-funded Girls
Research Opportunities in Computing (Girls R.O.C.) project conducted an
intense 3-week residential program to encourage and motivate seventh and
eighth grade female students to pursue the study of computer science with
emphasis on Information Technology (IT). Forty-eight girls were selected to
participate in the program during the 2-year span. These female participants
were selected from rural and urban school districts in northeast Louisiana.
Each year of the program a cohort of 24 girls participated in a 3-week
residential program on the campus of the University of Louisiana at Monroe
(ULM) followed by 3 follow-up Saturdays during the fall. The Computer
Attitude Questionnaire (CAQ) was used to measure the attitudes of the
participants with a pre, post and a 10-week follow-up evaluation. The changes
in attitudes were compared in terms of the program effectiveness. While these
initiatives were targeted to core factors affecting the low female
participation in IT, this research also examined if the findings for females
also applied to other underrepresented groups in information technology. The
analysis measured the effects of training on attitudes in the following
categories: Computer Importance, Computer Enjoyment, Study Habits,
Motivation/Persistence, Empathy, Creative Tendencies, Attitudes Toward
School, Computer Anxiety, Self Concept, E-Mail, the WWW, Integrated
Applications, and Graphics in respect to grade level and ethnic group. An
appendix includes the Subscale to Item Number Conversions. (Contains 11
references, 4 tables, and 4 figures.) (Author/AEF)

IT and The Attitudes of Middle School Girls: A Follow-up Study

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Abstract: Research has reported various explanations for the disinterest of girls with certain matters such as computer science, mathematics and science. Researchers have included factor such as, the societal views of an appropriate female career, the lack of female role models in these areas, gender bias in the classroom setting at this critical time in the female life, and gender stereotyping in computer software (2)&(3). The two-year NSF-funded Girls Research Opportunities in Computing (Girls R.O.C.) project was designed to address these issues by conducting an intense three-week residential program that would encourage and motivate seventh and eighth grade female students to pursue the study of computer science with emphasis on Information Technology (IT). Forty-eight girls were selected to participate in the program during the two-year span. These female participants were selected from rural and urban school districts in northeast Louisiana.

Each year of the program a cohort of 24 girls participated in a three-week residential program on the campus of The University of Louisiana at Monroe (ULM) followed by 3 follow-up Saturdays during the fall. To assess the attitudes toward IT, the Computer Attitude Questionnaire (CAQ) (7) was used to measure the attitudes of the participants with a pre, post and a ten-week follow-up evaluation. The changes in attitudes were compared in terms of the program effectiveness. While these initiatives were targeted to core factors affecting the low female participation in IT, this research also examined if the findings for females also applied to other underrepresented groups in information technology. The analysis measured the effects of training on attitudes in the

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following categories: Computer Importance, Computer Enjoyment, Study Habits, Motivation/Persistence, Empathy, Creative Tendencies, Attitudes Toward School, Computer Anxiety, Self Concept, E-Mail, the WWW, Integrated Applications, and Graphics in respect to grade level and ethnic group.

Introduction: Supporting Women in InFormation Technology (SWIFT) has identified several factors that they consider as the core factors that contribute to the lack of female participation in IT careers (3). These core items stem from several factors: the effect of societal labeling computer science as a hard-core male activity; lack of female role-models such as, IT teachers and females in IT industry; the tendency for boys to dominate computers at school and home along with the lack of computers used as teaching tools in the classroom results in less experience in computer usage for girls. This in turn contributes to computer anxiety and lower levels of self-perceived ability in computer science among female students (3)(6)&(10).

In the workplace one of the most dramatic changes has been the increased dependence on computers and computer-related technologies. In 1998 The Bureau of Labor Statistics reported that the top three fastest growing occupations from 1996-2006 are in the field of computer science (1). Yet recent studies indicate that women are significantly underrepresented in computer science degrees programs (8)&(2). Myers (1999) reported that only 14.4 percent of employees in IT are female (3). Many researchers have sought answers to the question of why girls do not pursue computer science degrees and careers in the computer related fields.

Research has shown that design and delivery of technological knowledge through educational software, web designed sites, and computer games appeal more to boys than girls (10). Computer use in schools has traditionally been linked to 'masculine' subjects such as science and mathematics rather than traditionally 'female' subjects such as liberal

art and literature (5). Shoffner (2001) reported that half of all teachers who have access to technology in their schools do not make use of it in their instruction (9). Janese Swanson, senior vice president of the Girl Tech Web site, states, "Shying away from technology not only restricts girls from certain life choices and successes, but also limits the potential for their future products, inventions, and discoveries – a disservice to the entire society" (10). In general the above research has reported various explanations for the disinterest of girls with certain subject matters such as computer science, mathematics and science.

The NSF-funded Girls Research Opportunities in Computing (Girls R.O.C) project was designed to address these issues by conducting an intense three-week summer program that would encourage enthusiasm for computers by providing female role models such as, ULM computer science faculty and majors, a non-competitive environment, and group research. The program provided both formal and informal activities for the girls in areas of computer applications, Internet research, email activities, graphics, and simulations along with a variety of classroom and hands-on activities that exposed them to ways that computers are used in research, business, and the home (4).

Participants: The 48 female participants were recruited from eighth and ninth grade girls from predominantly rural school districts in northeast Louisiana. These educational communities have high proportions of underrepresented students in IT career tracks. The girls were selected using several criteria that included a written essay, transcript of grades, and a recommendation from a counselor or teacher. Special consideration was given to minorities and students with disabilities.

This study consisted of the pre, post and follow-up survey results of 36 of the 48

girls who participated in the summer resident program. Twelve of the girls did not return

for the follow-up visits and, thus, were excluded form this study.

Objectives:
1. Mentoring/Role Modeling: Using Big Sisters to encourage IT as a career choice.
2. To foster a better understand of IT career opportunities:
    a. Invited Female Scientists and Educators as guest speakers and online chat sessions.
    b. Field trips to facilities where participants can see IT and computer professionals at work.
3. Classroom & Group activity:
    a. To experience classroom activities which are free of gender-bias and male competition.
    b. Research Groups to study and develop group oriented research projects.
4. Follow-up Visits: To encourage the participants to work on and complete a science fair project.

Activities: Program activities for Years 1 and 2 of Girls R.O.C. were essentially the same; however, there were two major differences. For Year 2 students, Space Science replaced word processing and spreadsheets, which proved to be an exciting change that dovetailed well with the MicroWorlds activities leading to the research projects. Secondly, the project director led all research projects, not the individual instructors as was done in the previous year. This focused approach for the Year 2 group appeared to be a more successful than the individual approach for the Year 1 group where the girls were divided into three different research project groups.

During both years the participants in Girls R.O.C. lived on campus for three weeks and then returned for three Saturdays in the fall. During the residential portion of the program, the participants (Little Sisters) were supervised in the dormitory by five female science majors (Big Sisters). The Big Sisters also assisted with daytime activities when they were not attending class thus reinforcing the role model exhibited by the instructor for the participants. Events for daily activity included Girl Talk a time for the project director to preview plans for the day and receive feedback from the participants.

Using Frontpage and Netscape Composer to create individual girl's web pages and to produce a weekly electronic newspaper. A daily Space Science activity from The Science Out of This World site at Northwestern State University (NSU) to encourage interest in mathematics and science related subjects. MicroWorlds was used to teach the girls about graphics and to create simulations for their research projects. Field trips included visits to the U.S. Corps of Engineers Waterways Experimental Station in Vicksburg Mississippi, to Black Bayou National Wildlife Refuge outside of Monroe Louisiana, and to the Space Camp at NSU. Computer Lab time was used for email, browsing and searching, and completing computer activities begun earlier in the day.

The activities that the girls enjoyed the most were those that allowed them to be creative. They thoroughly enjoyed creating their web pages and writing stories for the newspaper. They also enjoyed writing and illustrating stories with MicroWorlds. Writing fairy tales was by far the most successful single activity of the summer. Experimental activity such as a bubble experiment was designed to teach the girls about the scientific method. This project divided the girls into groups of four and asked to formulate hypotheses about the best way to create bubbles. They were then given supplies to test their hypotheses. The most successful space science activities were those that allowed the girls to play games and create things. They did not like activities that simply made them read and do research. However, if the reading and research were combined with a creative activity, they did not mind. For example, they had to do research to create a moon phase calculator, an activity that they really enjoyed. They then used this research to create a moon phase simulation during research project time. Likewise, they enjoyed doing research about the environments of planets of the Solar System in order to design

an alien, who could live on a specific planet. They followed each activity with a simulation program that was the product of a MicroWorlds project. In contrast, they did not enjoy researching and answering questions about solar cookers since this activity did not include a creative project.

The Survey Instrument

The Computer Attitude Questionnaire, CAQ version 5.27 (7), a self reporting instrument for measuring middle school and high school students' attitudes on all Young Children's Computer Inventory (YCCI) subscales along with Computer Anxiety and Self Concept, was used as the tool or instrument for assessing the attitudes of the middle school girls who participated in the Girls R.O.C. The CAQ is composed of seven (7) YCCI subscales – Computer Importance, Computer Enjoyment, Study Habits, Motivation/Persistence, Empathy, Creative Tendencies and Attitudes Toward School – plus additional subscales that assess Computer Anxiety and Self Concept, a General Computer Skill Level and a modified Technology Proficiency Self Assessment (TPSA). The TPSA subscales assess attitudes toward E-Mail, the WWW, Integrated Applications, and Graphics. The General Skill Level is a measure of a student's typical use of computers in school. The subscales of E-Mail, the WWW, Integrated Applications, and Graphics measure the student's proficiency level in using these four (4) areas of technology. (See Appendix)

Evaluation Procedures

The CAQ was administered Year 1 and 2 to the participants during three periods: at the outset of the 3-week program (pre-survey), at the end of the 3-week program (post-survey) and 10 weeks after the completion of the program (follow-up survey). The Year 1

and 2 participants grade level and race distributions are given in Table 1 and displayed in Figure 1 below. In this study, there were twenty-five 7th graders, twenty-two 8th graders while the two groups represented 18 Caucasians females and 29African-American..

Table 1
Grade and Race Distributions

| Year	Grade	Total	Caucasian	African-American
Year 1	7th	9	5	4
Year 2	7th	16	6	10
Total 7th		25	11	14
Year 1	8th	15	6	9
Year 2	8th	7	1	6
Total 8th		22	7	15

Figure 1
Grade and Race Distributions
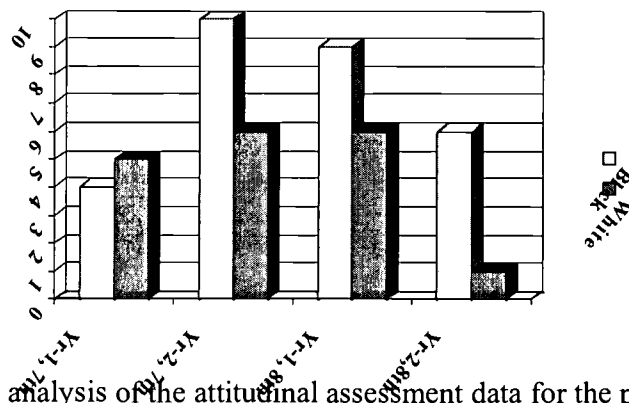
The initial analysis of the attitudinal assessment data for the participants representing the two groups -- Year 1 and Year 2 -- were measured for each of the thirteen subscales of the CAQ and averaged over the three time periods producing six evaluation clusters. Friedman's analysis of variance by ranks was used to delineate any and all differences among the clusters in question. The first level of analysis compares the six groups by time clusters. The mean ranks for each of these clusters is shown in Table 2 and depicted in Figure 2. Friedman's ANOVA indicates that differences among the six clusters is present ($\chi^2 = 34.231$, p = 0.0000, df = 5).

Table 2
Group by Time
Average Ranks over CAQ Subscales

Time	Group	
	1	2
Pre	1.46	2.23
Post	3.77	4.15
Follow-up	4.46	4.92

Figure 2
Group by Time
Average Ranks over CAQ Subscales
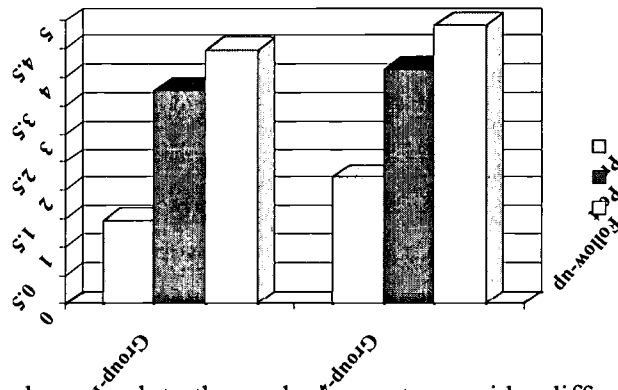
The second approach to the analysis was to consider differences among the attitudes attributed to grade level. The average ranks of the CAQ subscale data for the 7th grade girls was 1.62; whereas, the average rank for the 8th grade girls was 1.38. Friedman's ANOVA indicated no differences in attitudinal assessment by grade ($\chi^2 = 0.692$, p = 0.405, df = 1). A further comparison of grade by time cluster indicated that differences were present (($\chi^2 = 41.849$, p = 0.000, df = 11). Table 3 and Figure 3 display the average ranks for this classification.

Table 3
Average Ranks by Group, Grade and Testing Period

		Grade	
	Time	7th	8th
Year 1 Group	Pre	4.00	3.27
	Post	7.88	5.27
	Follow-up	8.04	7.19
Year 2 Group	Pre	4.50	5.62
	Post	6.81	7.77
	Follow-up	9.69	7.96

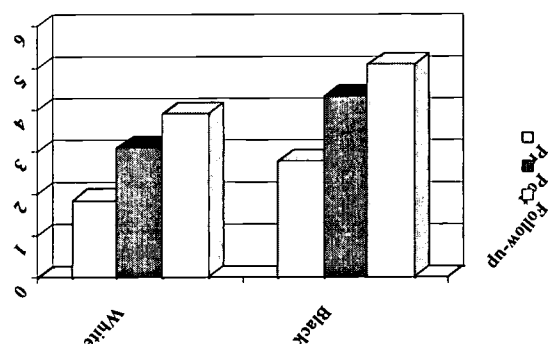Figure 3
Average Ranks by Group, Grade and Testing Period
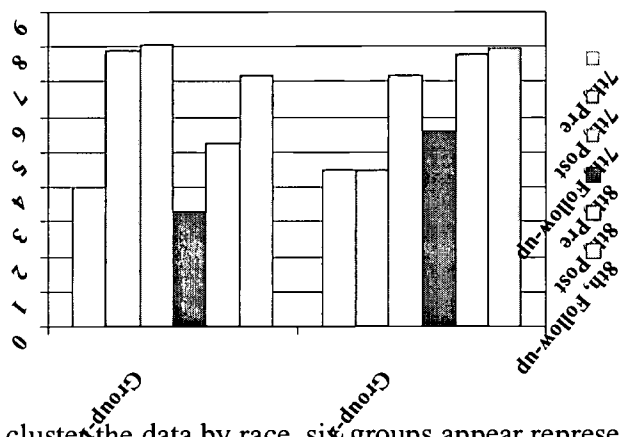
Where cluster the data by race, six groups appear representing average attitudinal

assessment values by race and time. Table 4 and Figure 4 show the average ranks of

these clusters. Friedman's ANOVA indicates that differences among the six groups are

present ($\chi^2 = 25.132$, p = 0.0000, df = 5).

Table 4
Average Ranks by Race and Testing Period

	Race	
Time	White	Black
Pre	1.85	2.77
Post	3.08	4.31
Follow-up	3.92	5.08

Figure 4
Average Ranks by Race and Testing Period

Summary and Conclusions: A 1998 Association for Computing Machinery (ACM) report stated that women composed less than one-third of the computer scientists and programmers in the U.S. This figure was barely twice the number reported in 1988 and was still less than half a million women. A 1997 Global Strategy Group poll reported that 49 percent of the college-bound females that were interviewed indicated that the technology industry was too boring, too difficult, or too technical. According to Linda Sanford, General Manager of Global Industries at IBM (11), "if girls were taught at an early age that engineering and computer science are more about problem solving than about freckles and Coke-bottle glasses, we'd see a greater number of girls and women interested in technology."

A major purpose of the Girls R.O.C. program was to increase female awareness of and to foster better attitudes toward the latest technologies in computer science. The CAQ subscales measure the attitudes of students in relation to various topics. While some attitudes are closely tied to their local school environments, others relate to the confidence level, which they have gained through the exposure to female mentors during the three-week Girls R.O.C. program. The ratings from the surveys provided evidence

that changes in the participants' confidence in using E-Mail, the WWW, Integrated

Applications and Graphics was greatly improved as a result of the three-week residential

program for each of the two groups of girls. Additionally, the improvements in attitudes

observed during the first year of the project toward E-Mail, the WWW, Integrated

Applications and Graphics were replicated during the second year of the project. This

latter finding further supports the findings of earlier studies about the Girl's R.O.C. on the

importance of introducing female students to technology at an earlier age.

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Appendix

Subscale to Item Number Conversions

Subscale	Part	Item Numbers
Computer Importance	1	3, 6, 7, 8, 10, 11
Computer Enjoyment	1	1, 2, 4, 5, 9, 12, 13, 15, 18
Study Habits	2	21, 24, 25, 26, 29, 30, 31, 32, 33, 34
Motivation/Persistence	2	21, 22, 23, 25, 27, 28, 29, 34
Empathy	3	36, 37, 38, 39, 40, 41, 42, 43, 44, 45
Creative Tendencies	4	46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58
Attitudes Toward School	6	62, 63, 64, 65, 66, 67
Computer Anxiety	1	12, 13, 14, 15, 16, 17, 18, 19
Self Concept	7	68, 69, 70, 71, 72, 73, 74, 75, 76, 77
E-Mail	9	85, 86, 87
WWW	9	88, 89, 90, 91
Integrated Applications	9	92, 93, 94
Graphics	9	95

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